LUMI Detector fabrication and testing

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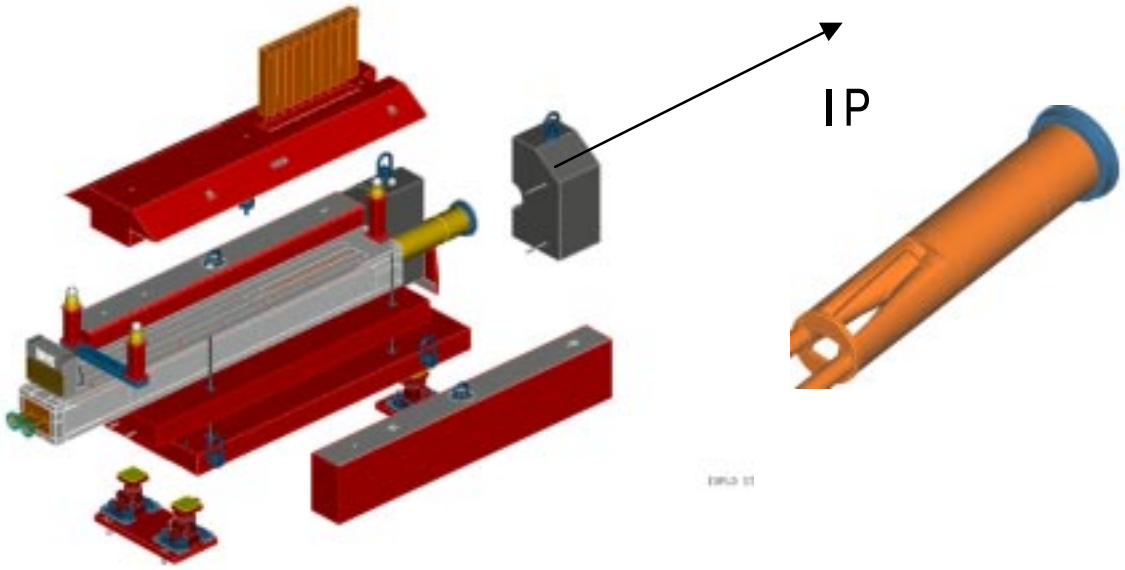
Outline

- Systems description
- The test stand
- Testing plan
- Early test results
- Upcoming events
- Conclusions

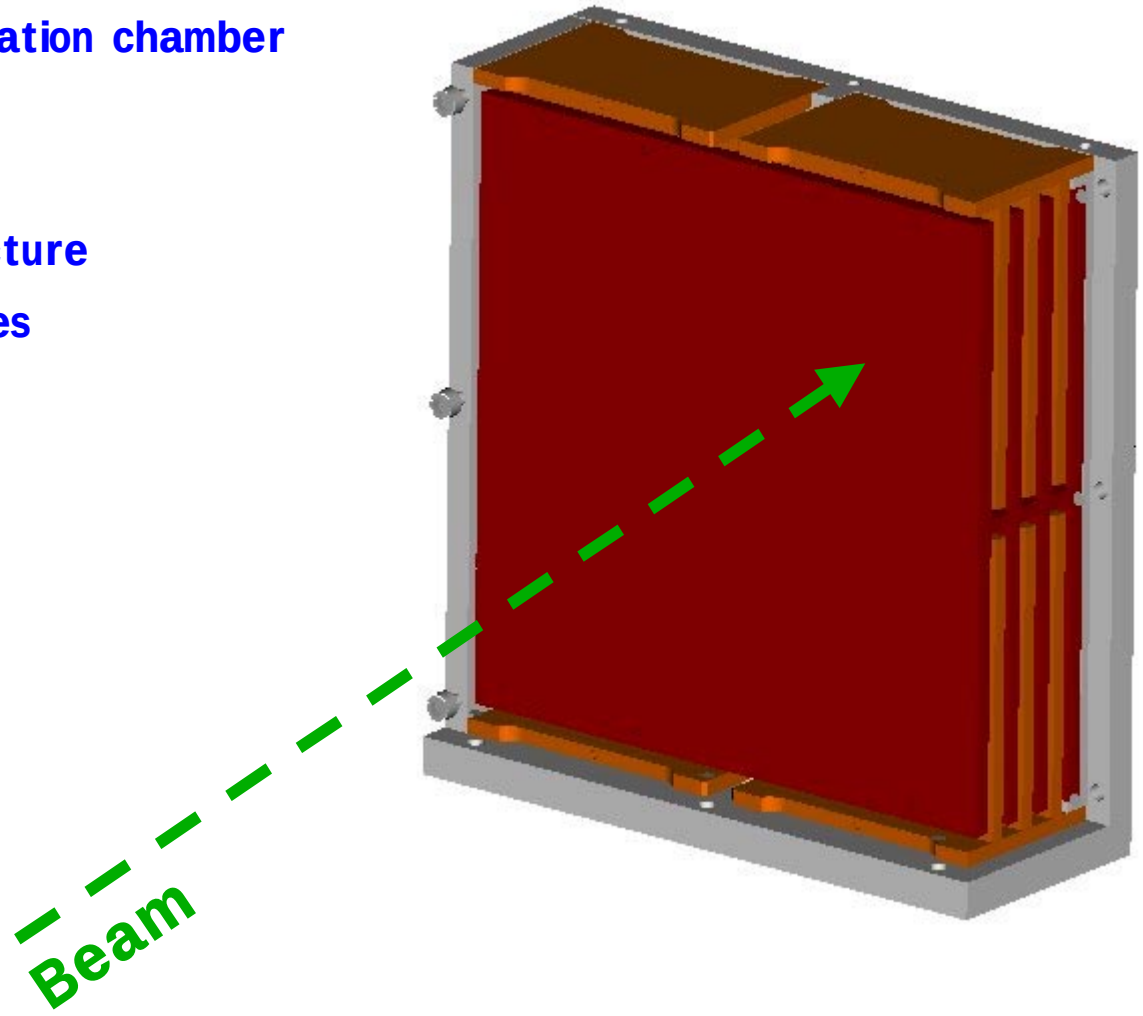
System description

- **Instrument TAN**
- **Argon ionization chamber**
- **Very high radiation environment**
- **Several years of development in both technologies**

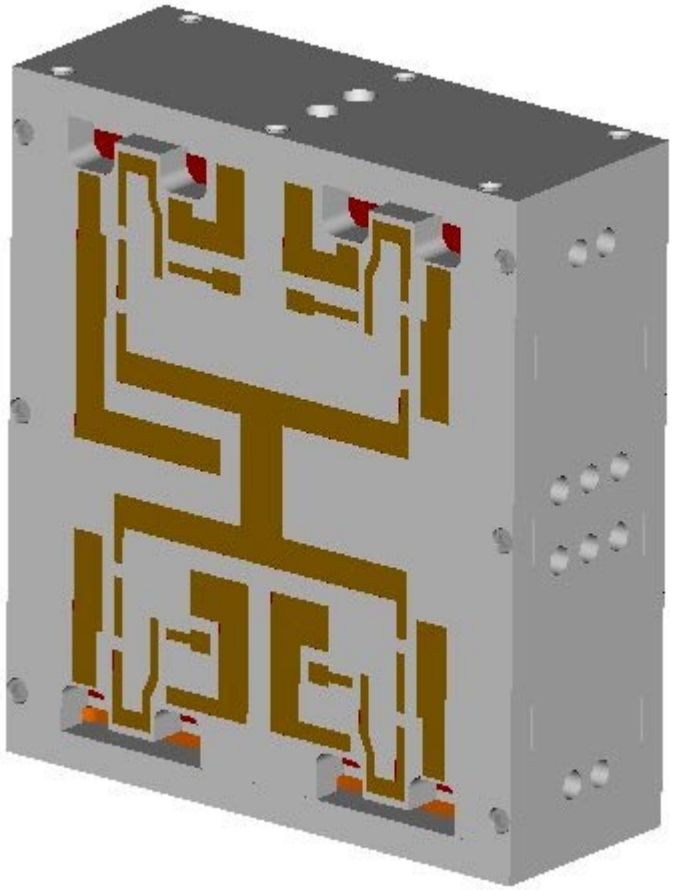


Detector highlights

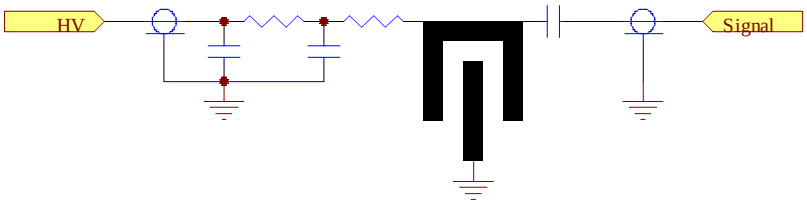
- 4 quadrant gas ionization chamber
- 6x1 mm gaps
- Ar + N_2
- Central ground structure
- 4 quadrant electrodes



Detector detail

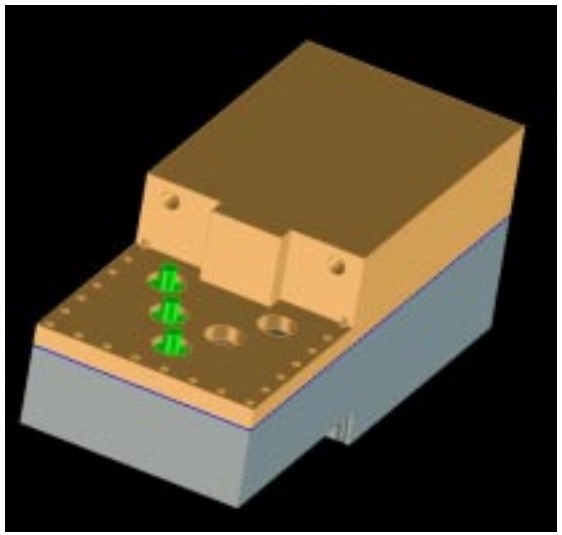


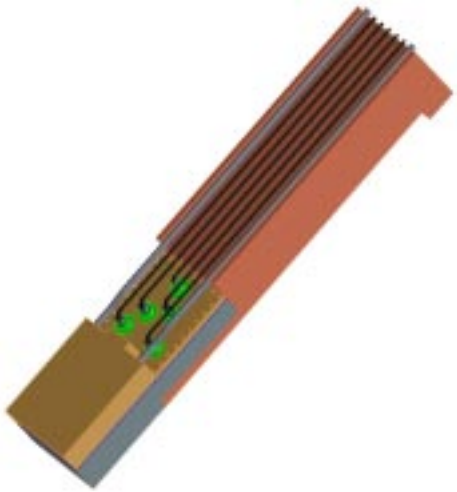
One ceramic face is metallized for bias filter and connections to rad-hard coax cable.



Fabrication status

- **Fabrication complete**
  - Some improvements under study
- **Rad hard cables and ceramic feedthroughs not presently in use**
  - Available for installation
- **Electronics improved since 2001 run at LHC**



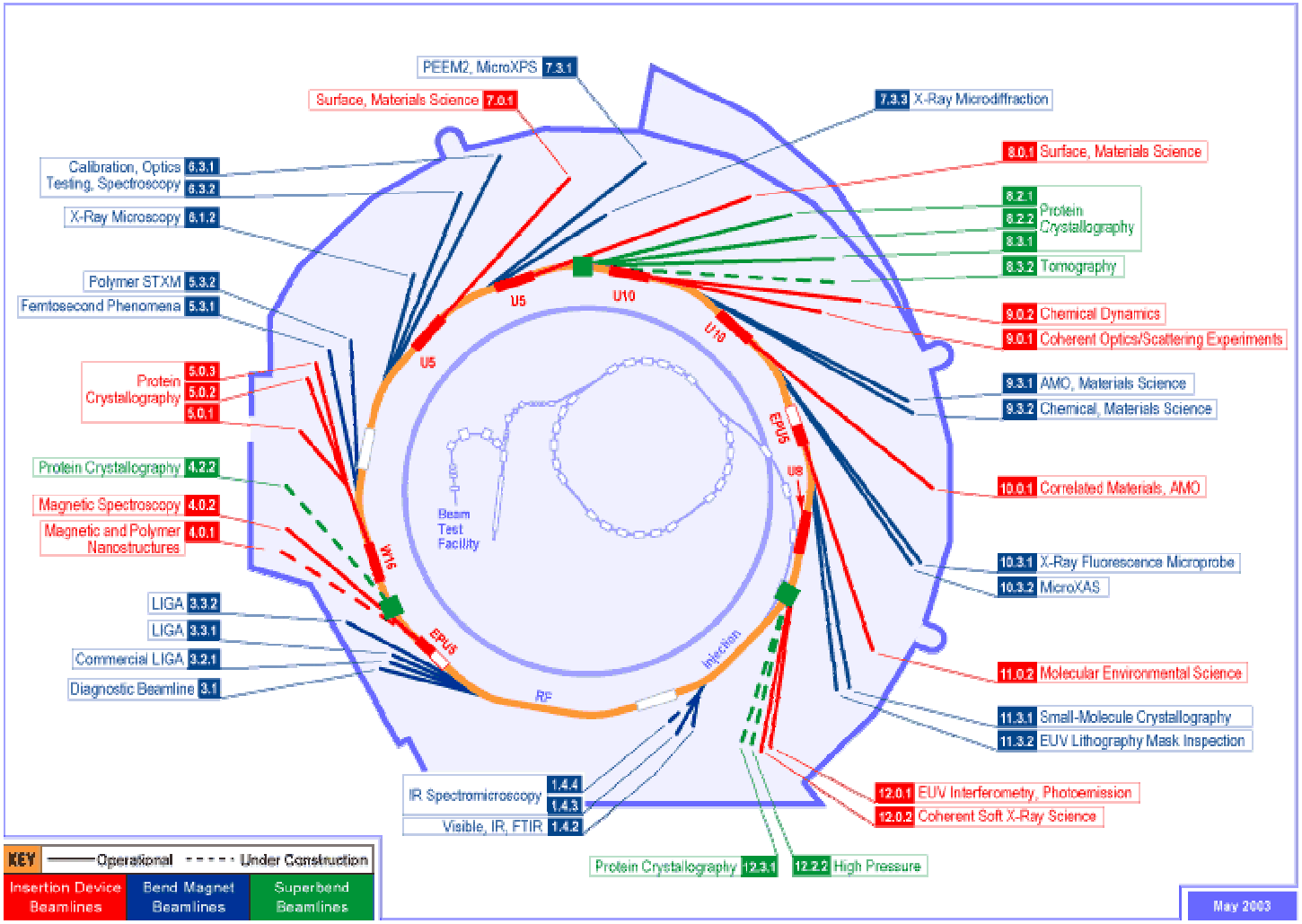


Detector Assembly

The test stand at the ALS

- 1.5 GeV e^- from the Booster
  - Available 90% of the time
  - Ideal pencil beam (~1 sq. mm)
- Very large dynamic range of bunch current
  - From a few to 10^10 electrons
- 1 Hz rep rate
- Mounted on X-Y motion stages
- LabView based DAQ system for data recording
  - Used during the tests at CERN in 2000, 2001
- Looking at testing 40 MHz performance looking at electron losses in the ALS main ring, loading a 40 MHz bunch pattern

The ALS accelerator



CdTe detector

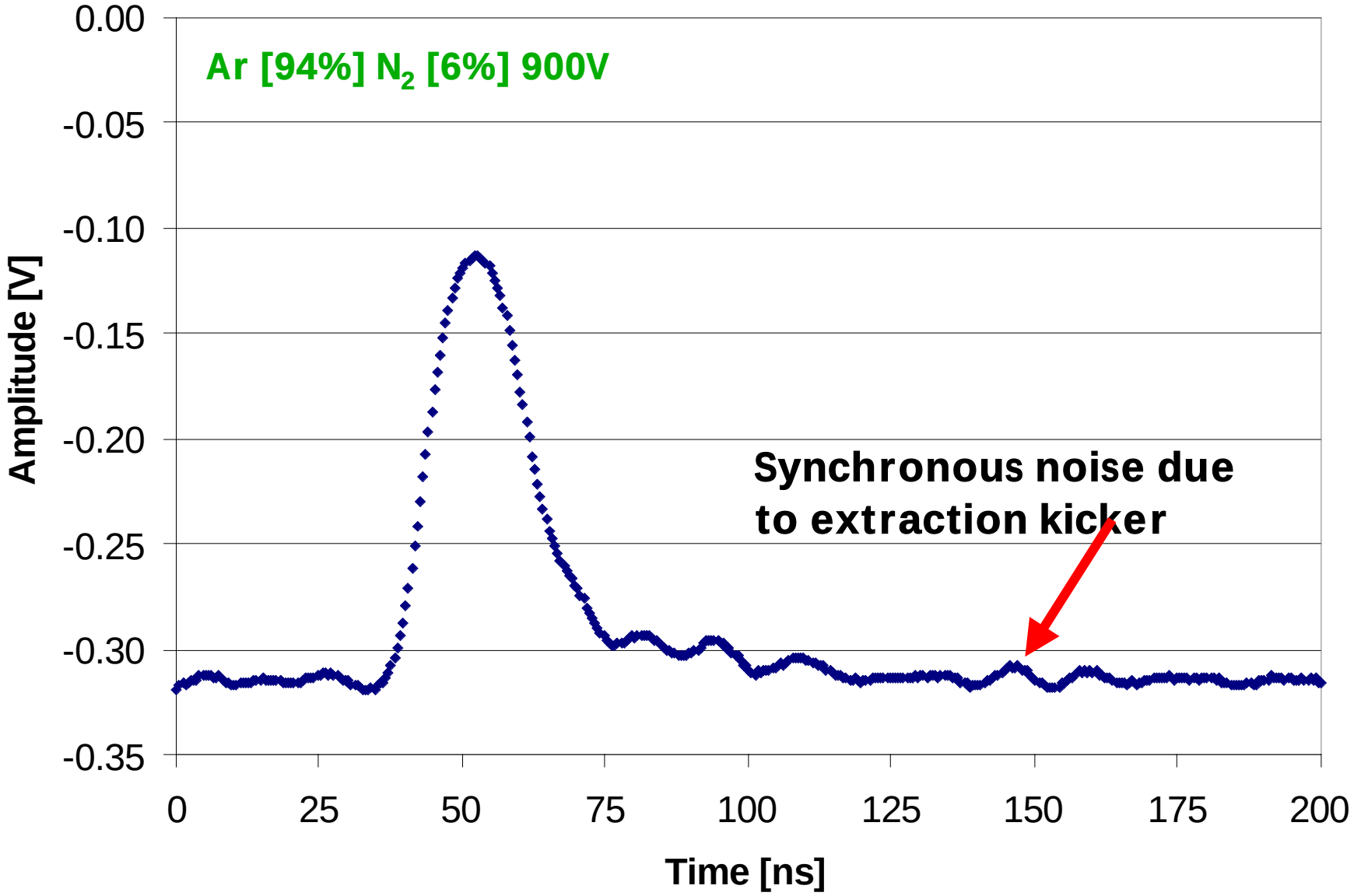
- Received from CERN in early September
- Complete with rad hard cables and front end electronics
- Installed at ALS
  - Mounted on the back of the ionization chamber
  - Requires good alignment
- Can take direct comparable data

Testing plan and early results

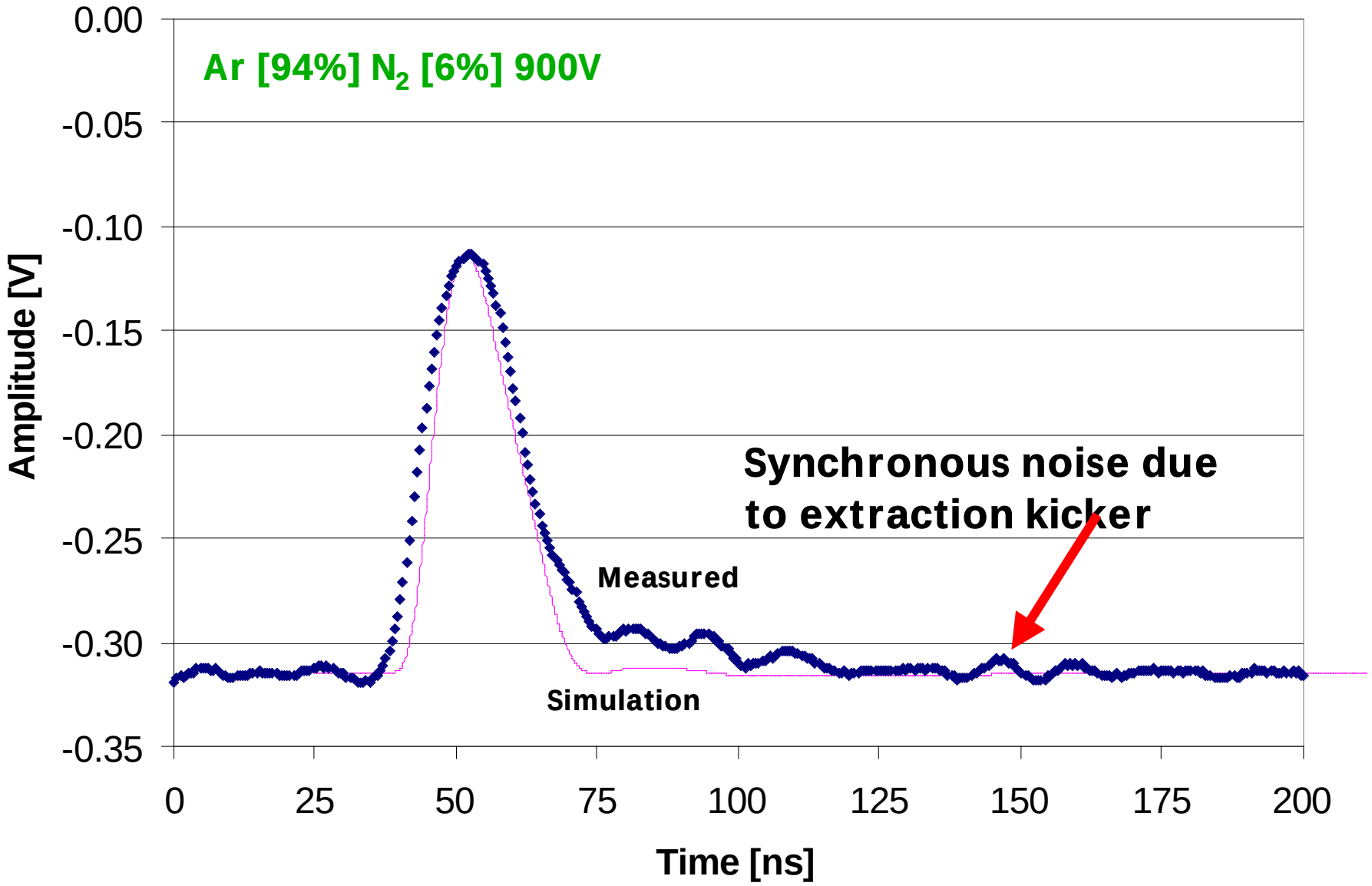
- **Full performance characterization at ALS Booster**
  - Gas mixture and pressure
  - Bias voltage
  - Linearity and position sensitivity
  - Full comparison of CdTe with ionozation chamber
- **40 MHz test at ALS under study**
- **Radiation damage performance at RDF at FNAL Booster**

- **Early test results**
  - Response vs. voltage
  - Pulse shape
- **Pencil e^- beam scanned vertically across 2 quadrants**
- **No optimization yet for voltage, etc.**

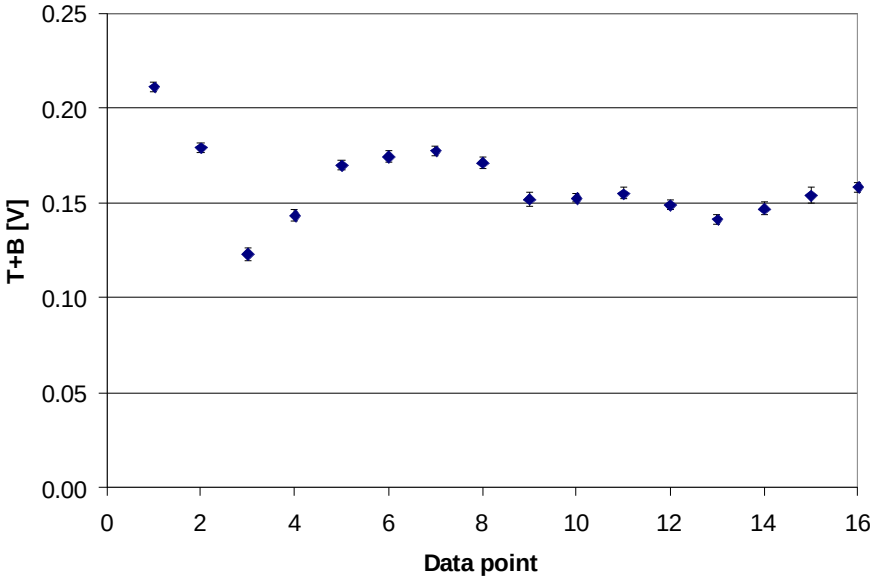
Typical signal (Average of several pulses)



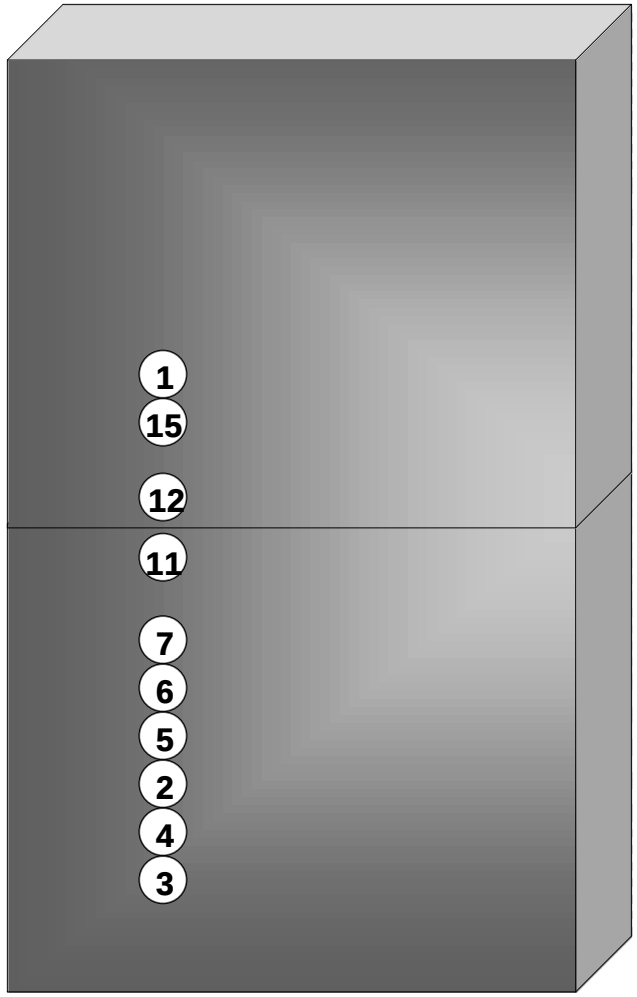
Typical signal (Average of several pulses)



Scan Across Quadrants

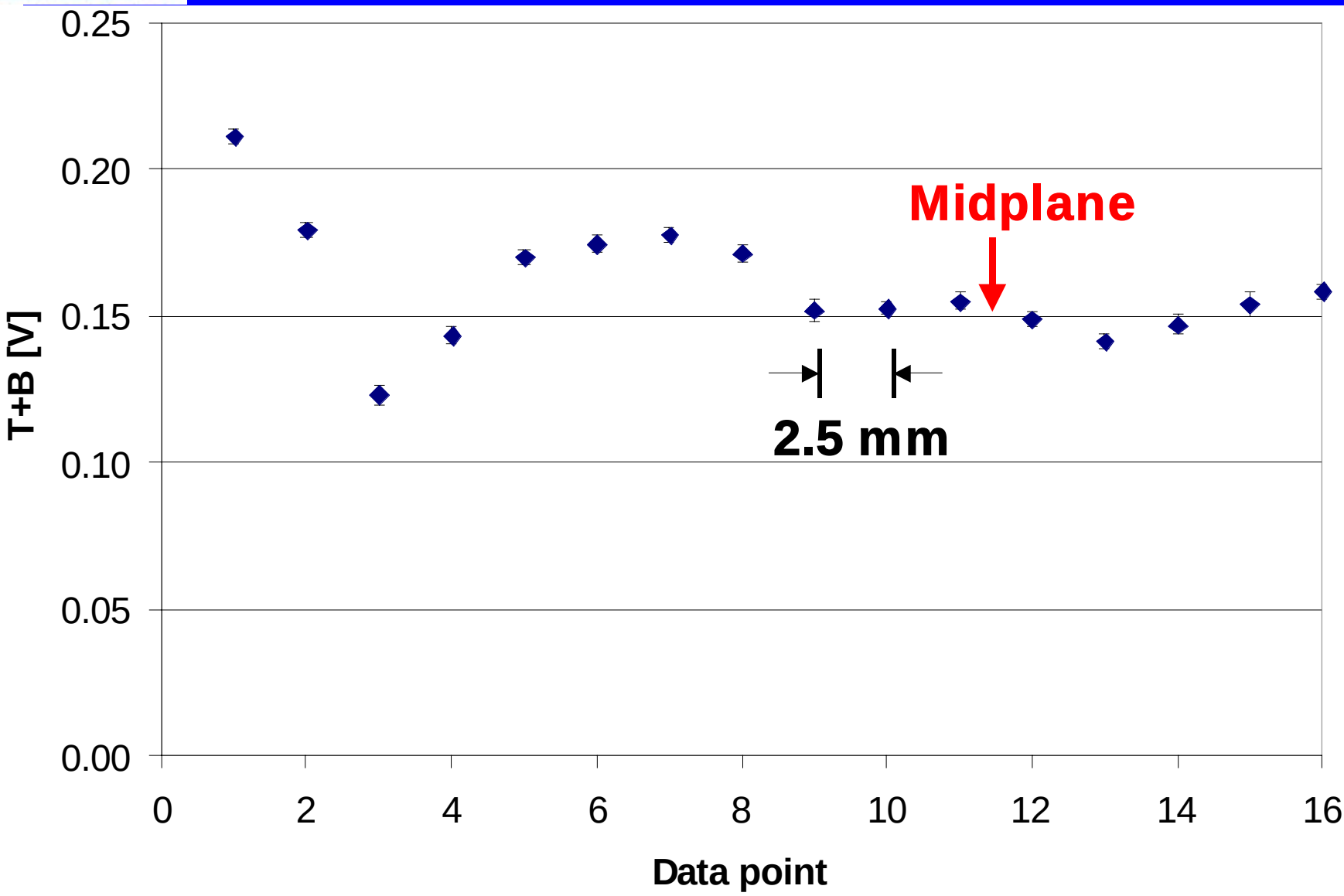


- No normalization
- Average of 10-20 pulses
- Look at [T-B]/[T+B]

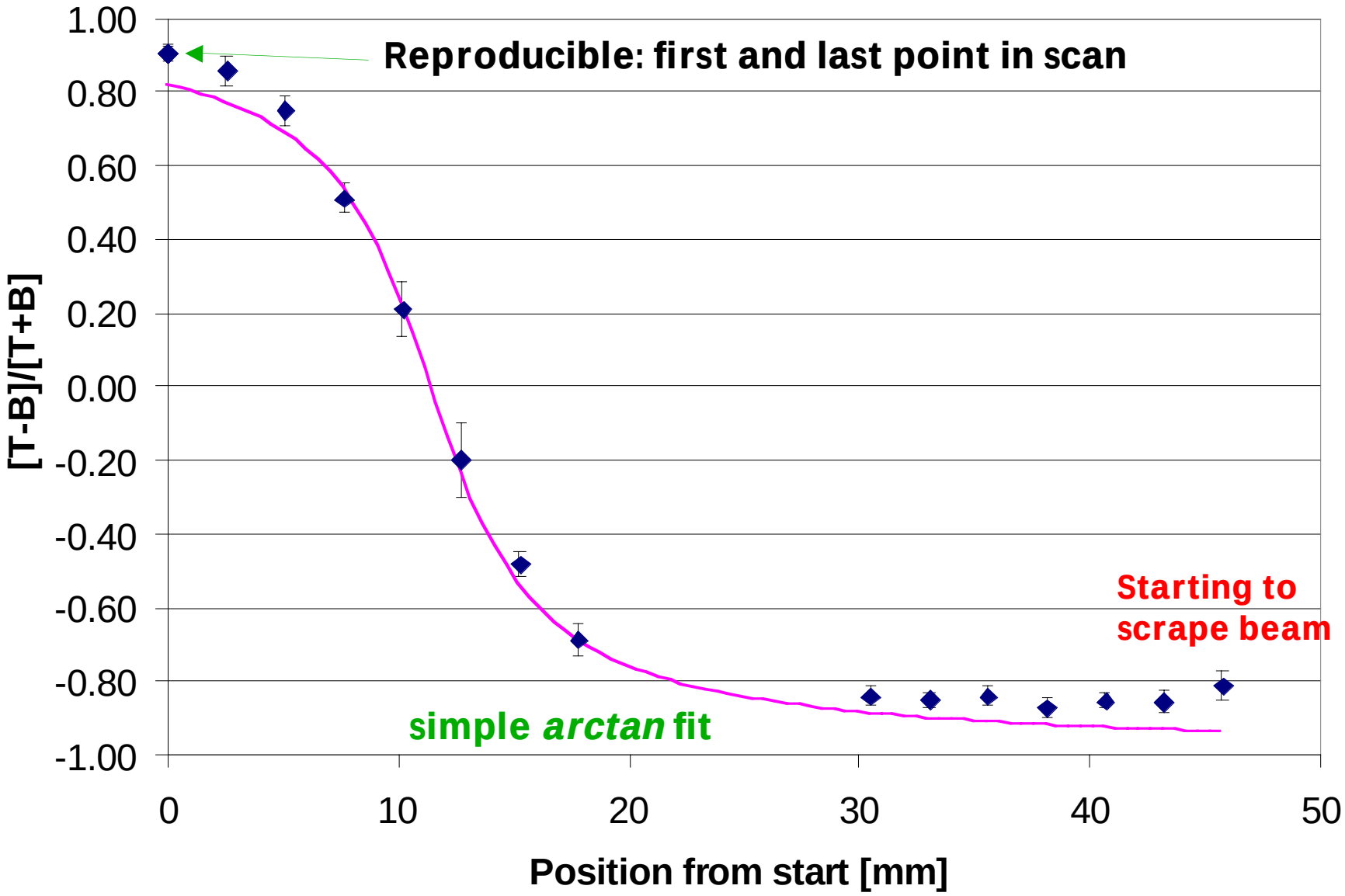


Peter: Need to cross-check magnet - to - position formula

No significant loss across quadrants

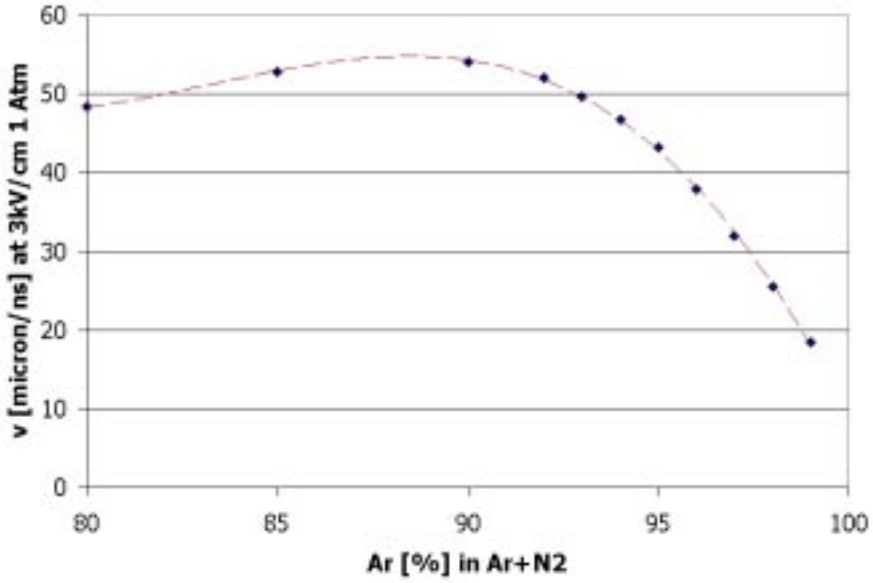


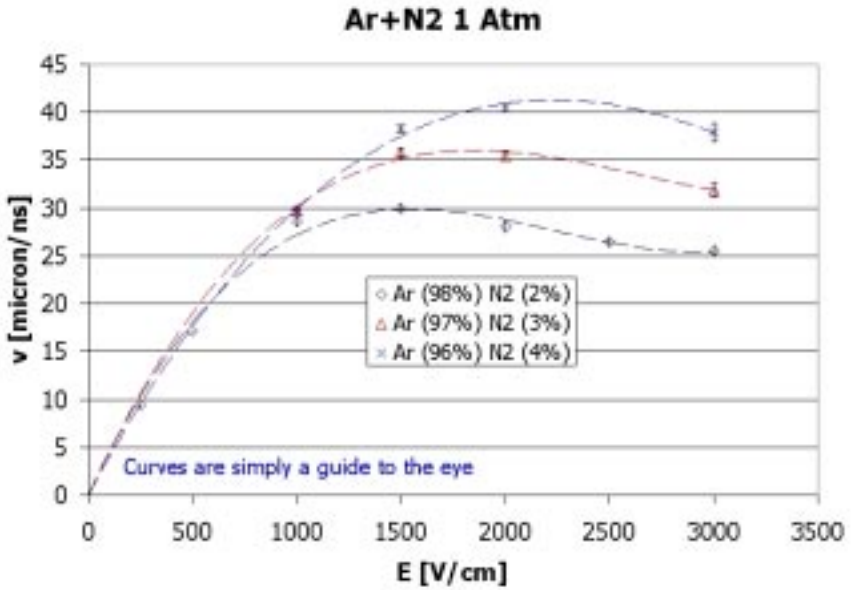
Scan


Reproducible: first and last point in scan
Starting to scrape beam
simple *arctan* fit
[T-B]/[T+B]
1.00
0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
-1.00
0
10
20
30
40
50
Position from start [mm]

Reference performance (from modeling)

Drift speed vs. gas mixture and bias voltage

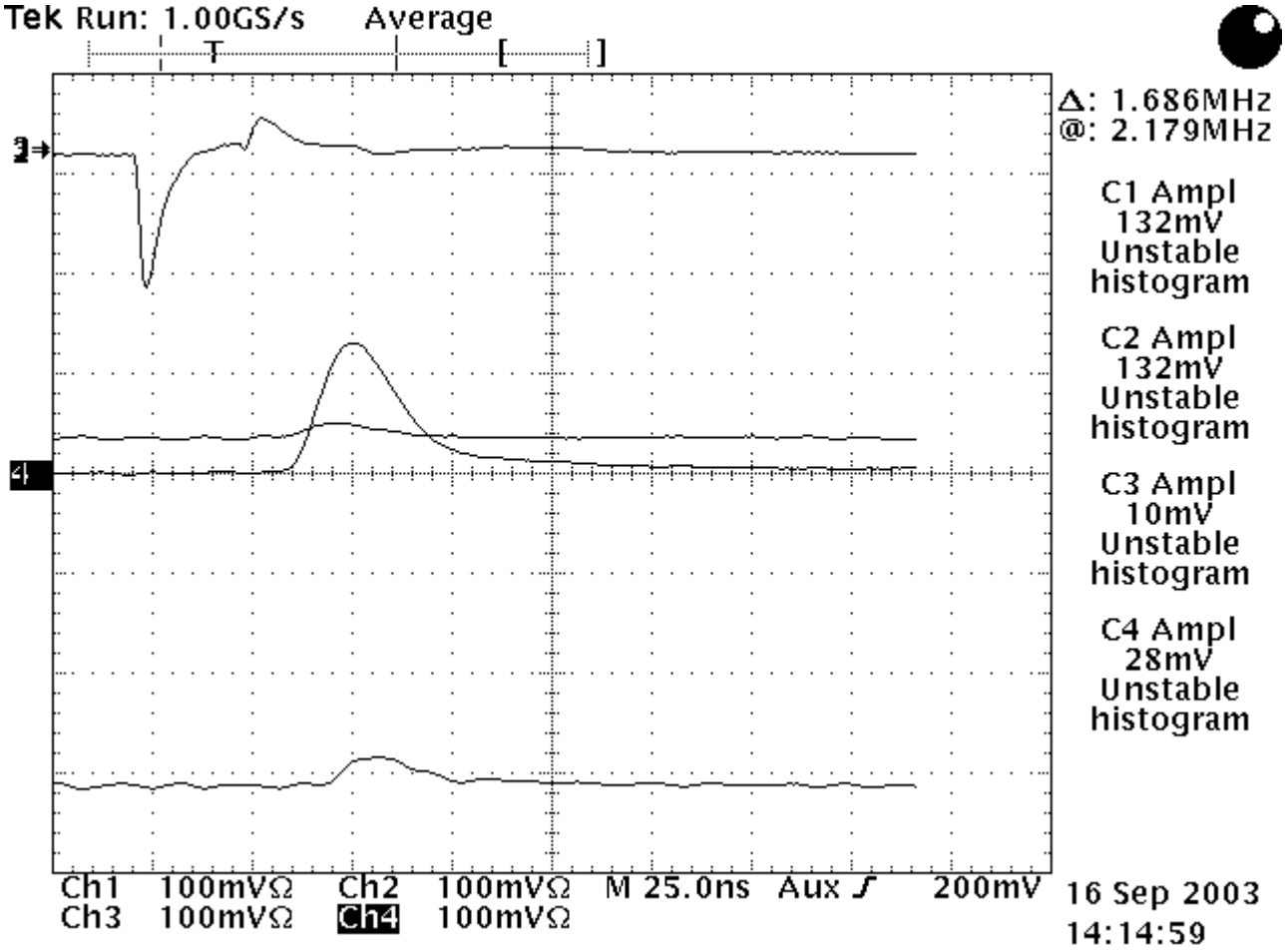




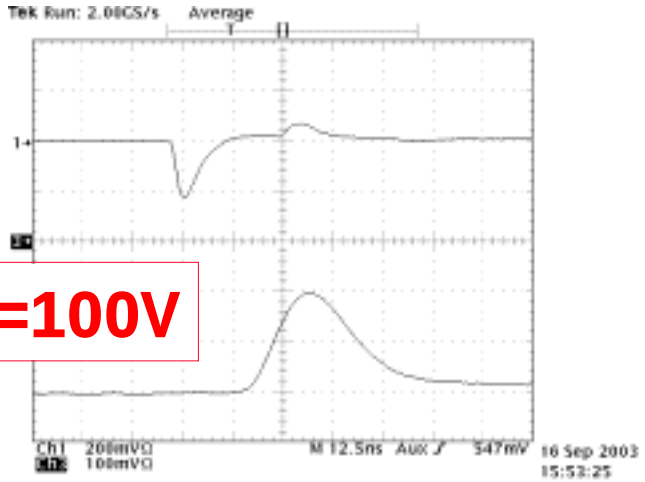
Early CdTe results

CdTe

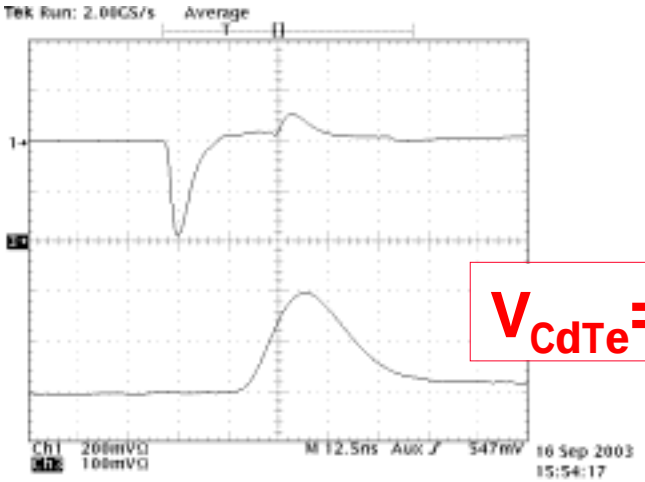
Gas Quadrants



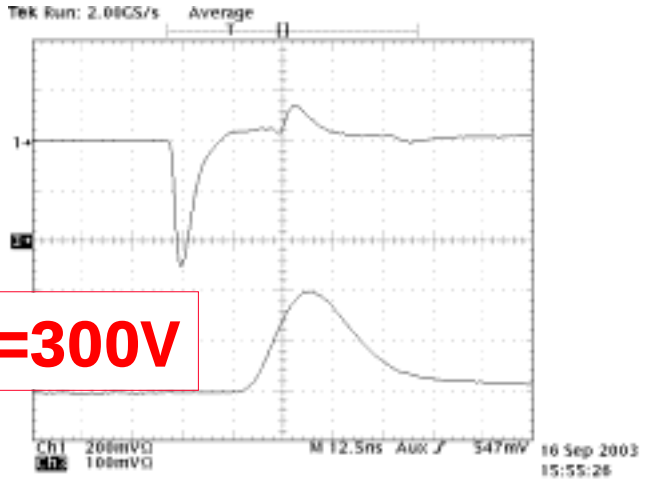
CdTe Signal vs. Bias Voltage



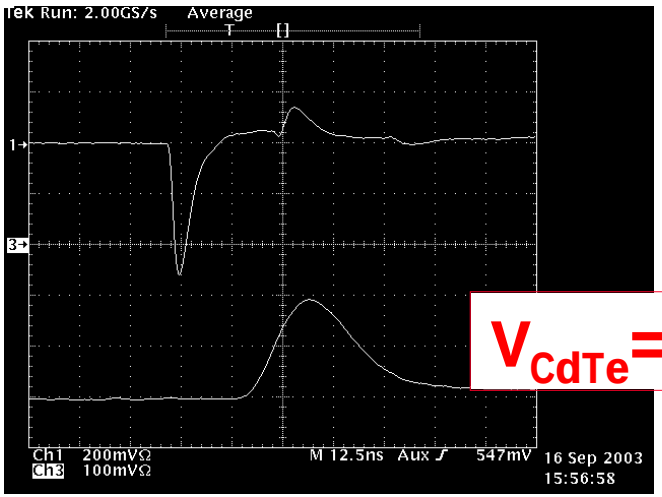
V_{CdTe}=100V



V_{CdTe}=200V



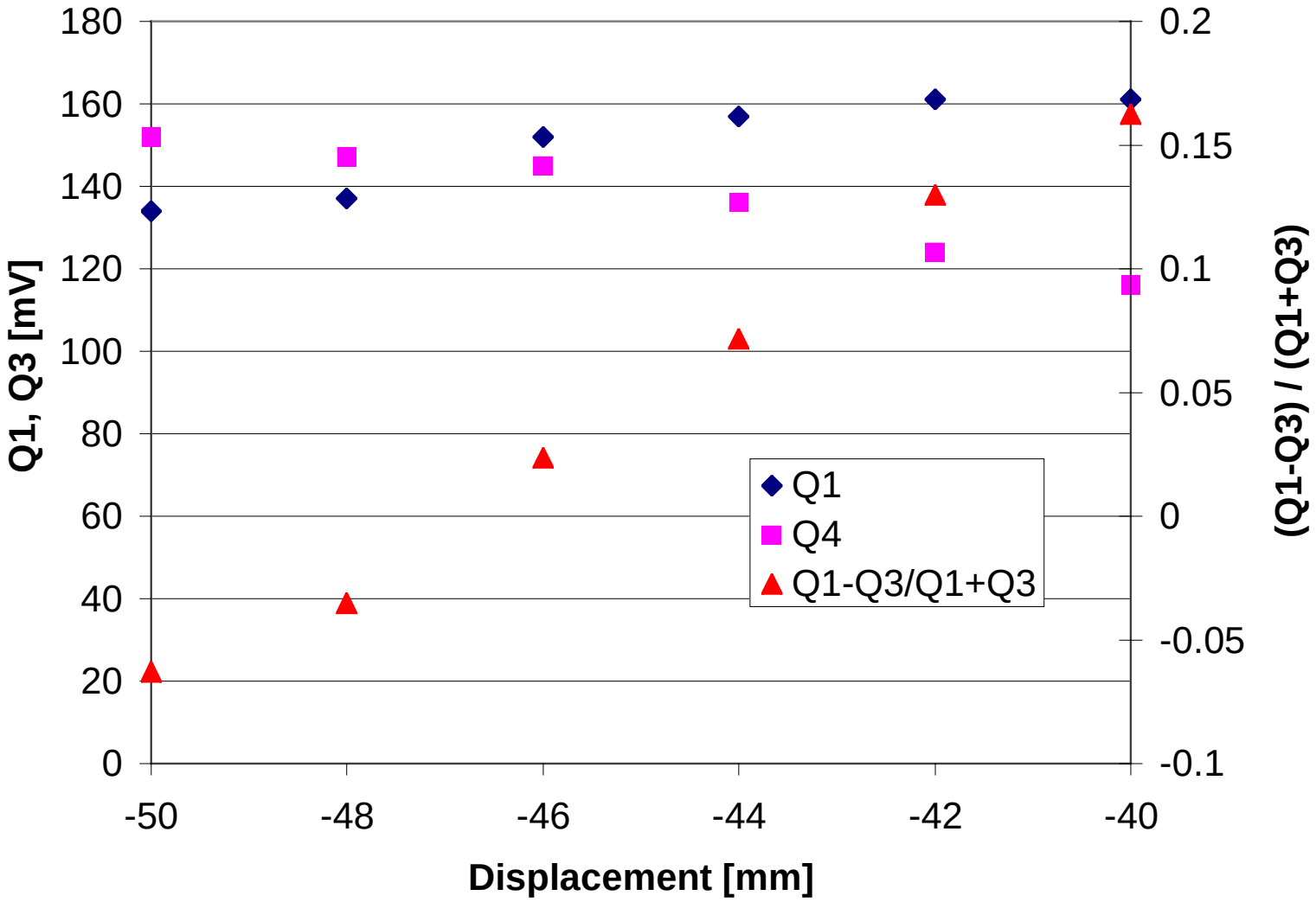
V_{CdTe}=300V



V_{CdTe}=400V

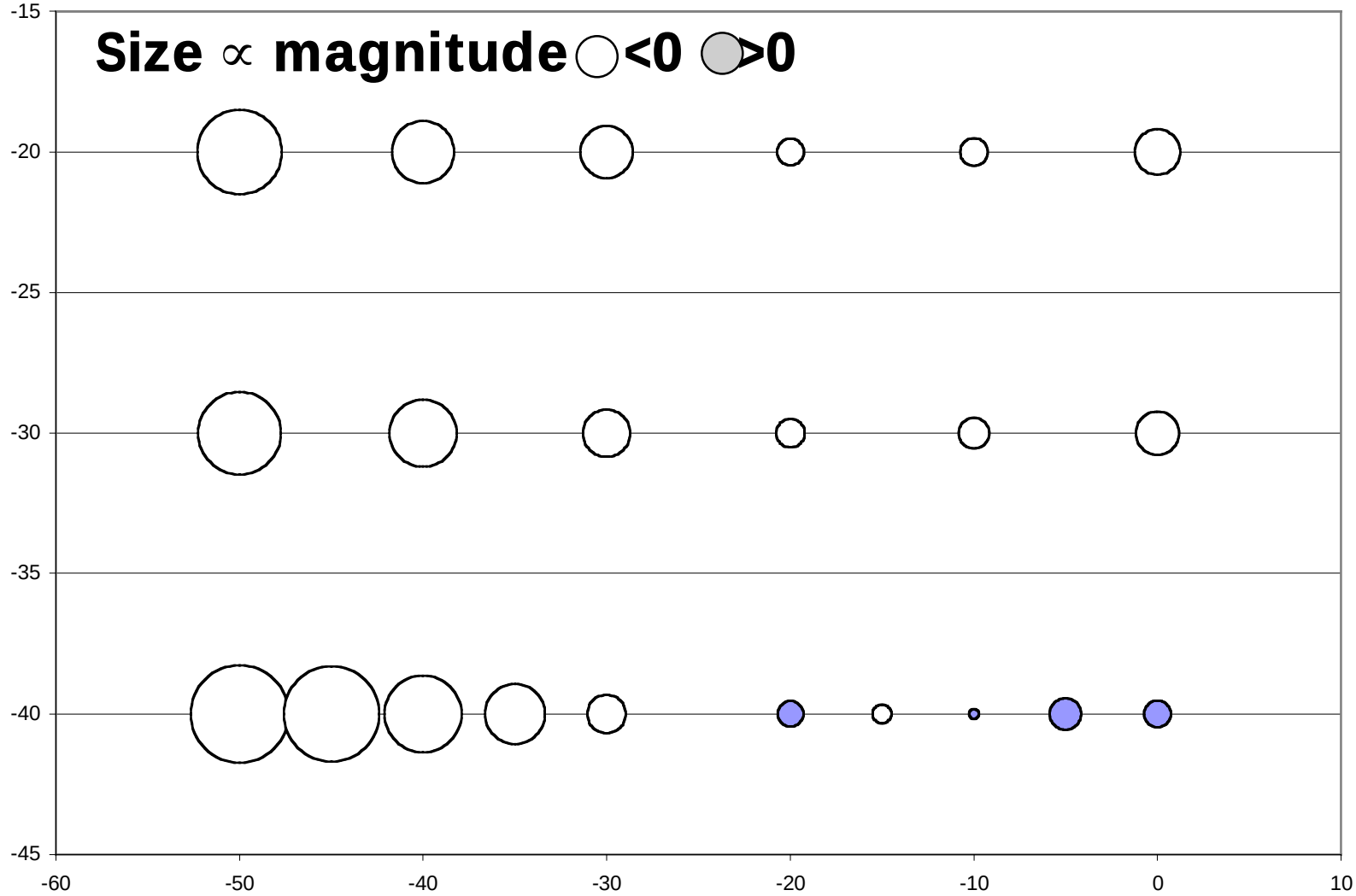
Scan Ionization Chamber

Scan across a gap - no beam normalization

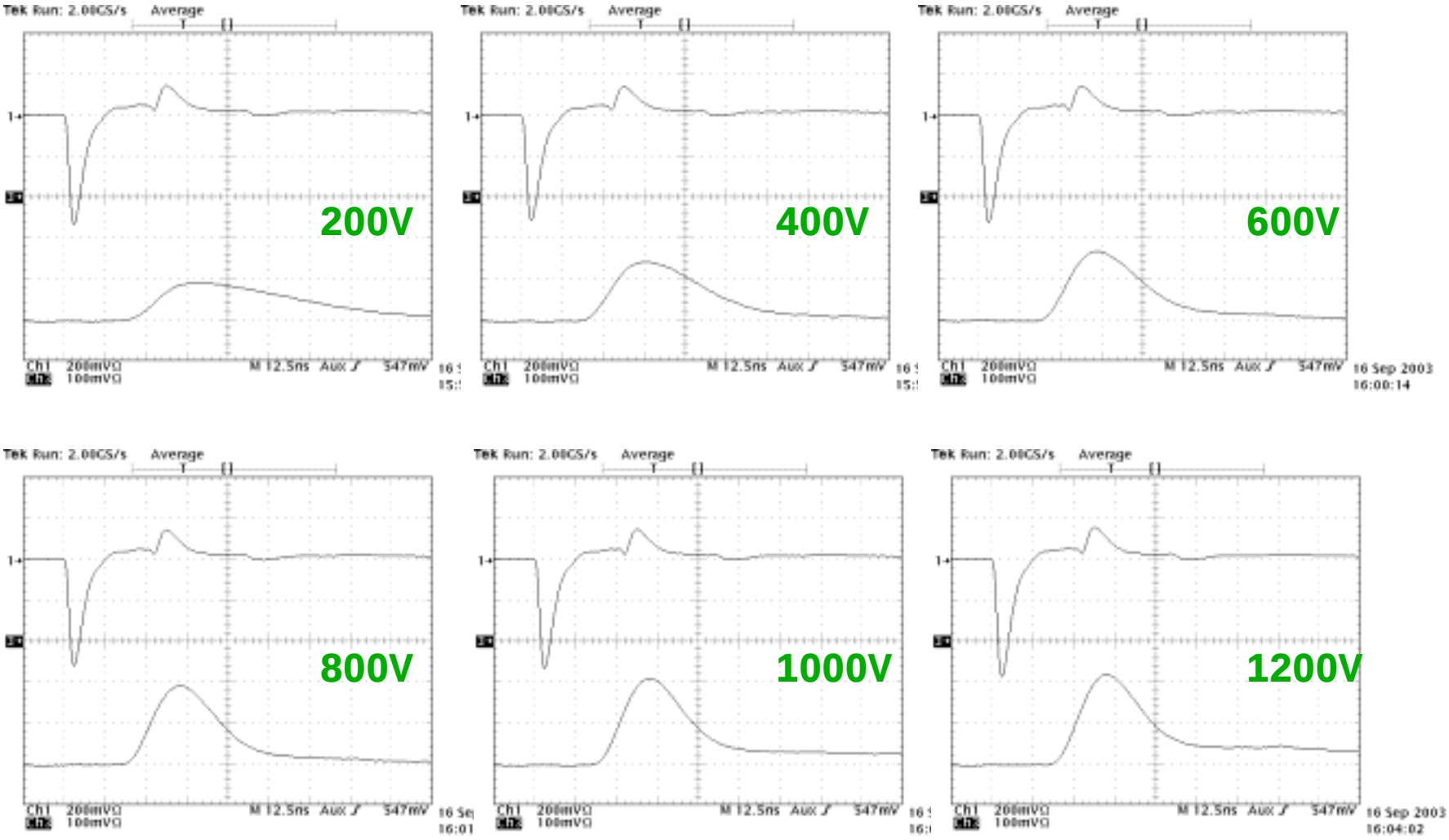


Scan CdTe (2 disks)

Table travel limited



CdTe@400V, Vary V(gas)



Upcoming events

- **Complete the measurements on the current devices**
  - Test all gas mixtures (2,4,6,8, 10%) and optimize bias voltage
  - Measure linearity and performance as BPM
  - Optimize electronics for fast response
  - Compare two technologies
- **Perform a test at 40 MHz**
- **Compare with simulation results**
  - Validate codes
- **Radiation hardness test**
  - At FNAL?? (see next presentation)

Conclusions

- **The LUMI detector is built and undergoing systematic testing**
  - **CdTe is also installed: the two devices can be used for relative measurements**
- **A very versatile and user friendly setup is now available**
- **A radiation test at the FNAL Booster was planned**
- **Initial measurements indicate satisfactory performances**